

Background

- Hurricanes Laura (2020) and Florence (2018) were devastating tropical cyclones (TC) that underwent rapid intensification (RI) before making their impact to land
- Lightning within these TCs can indicate changes within the eyewall using the average flash area (AFA), flash extent density (FED), and optical energy

Data and Methods

- 1-minute data from the Geostationary Lightning Mapper (GLM) was used to acquire AFA, FED, and optical energy measurements
- The NHC Best Track data was interpolated to estimate the center of the storms and determine when the most RI took place
- This subset of data provided measurements of lightning during the period of strongest RI. A time series was made using a mean of all of the energy values each minute within 100 km of the center of the storm

Acknowledgements

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Hurricane Laura

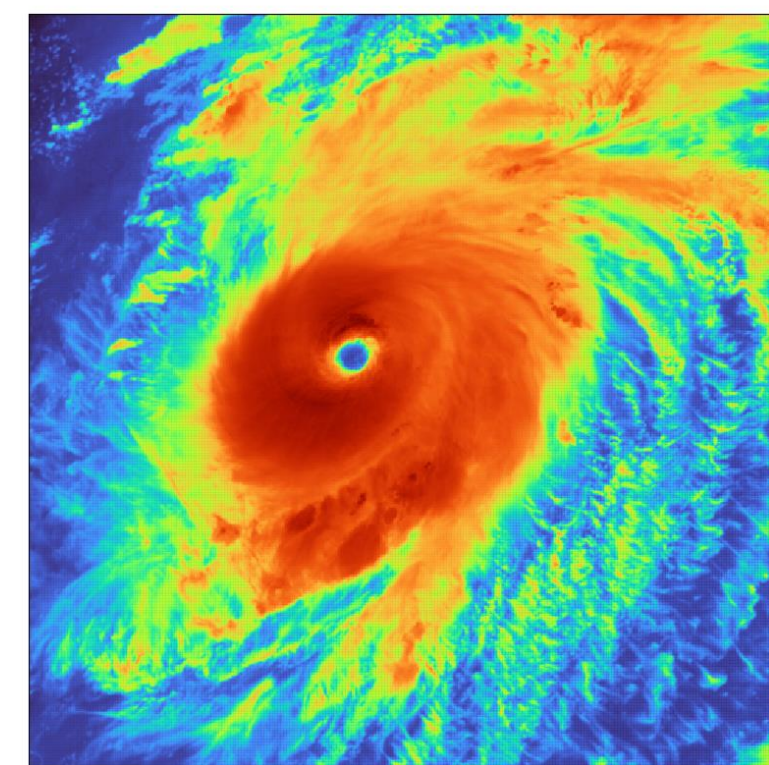


Figure 1: Infrared image from the GOES-16 satellite using band 13 to show brightness temperatures in Hurricane Laura on 27 August 2020 at 0000Z

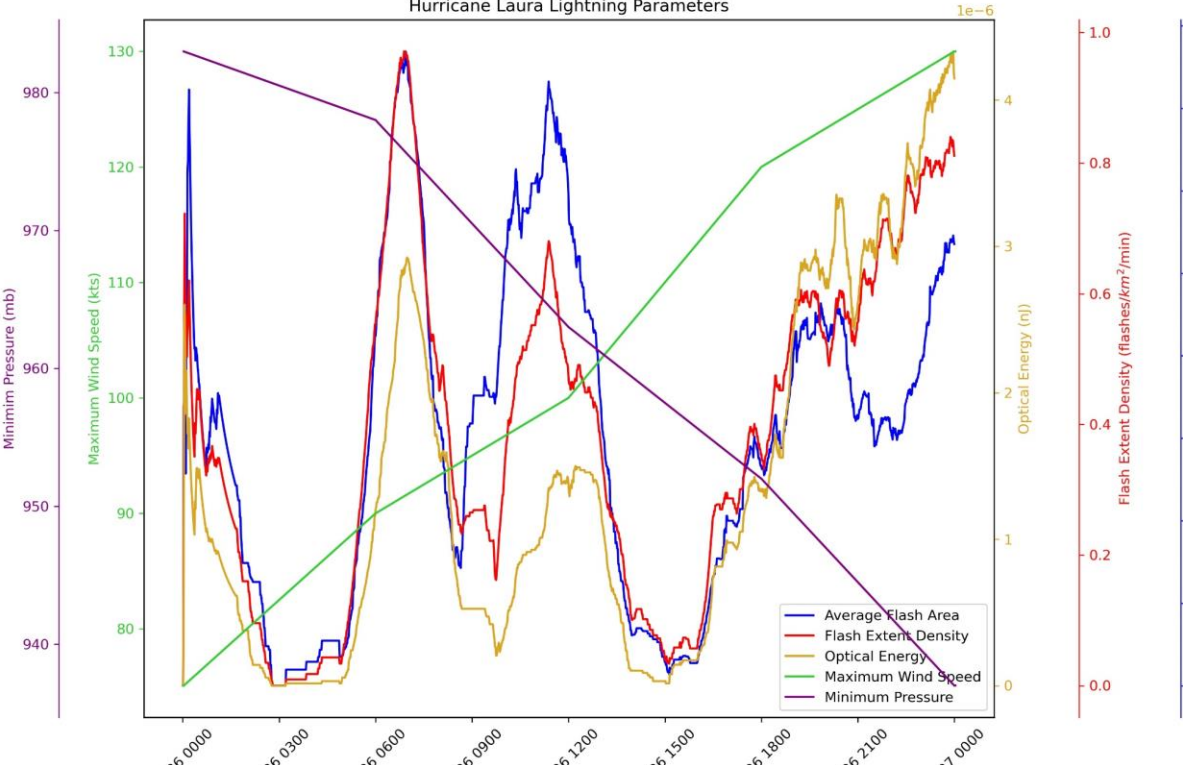


Figure 2: Maximum wind, minimum pressure, AFA, FED, and optical energy in Hurricane Laura from 26 August 0000Z to 27 August 0000Z

- Just prior to an increase in intensification rate at 1200Z, AFA, FED, and optical energy increased and then dropped dramatically
- Optical energy deviated from AFA and FED as intensification increased

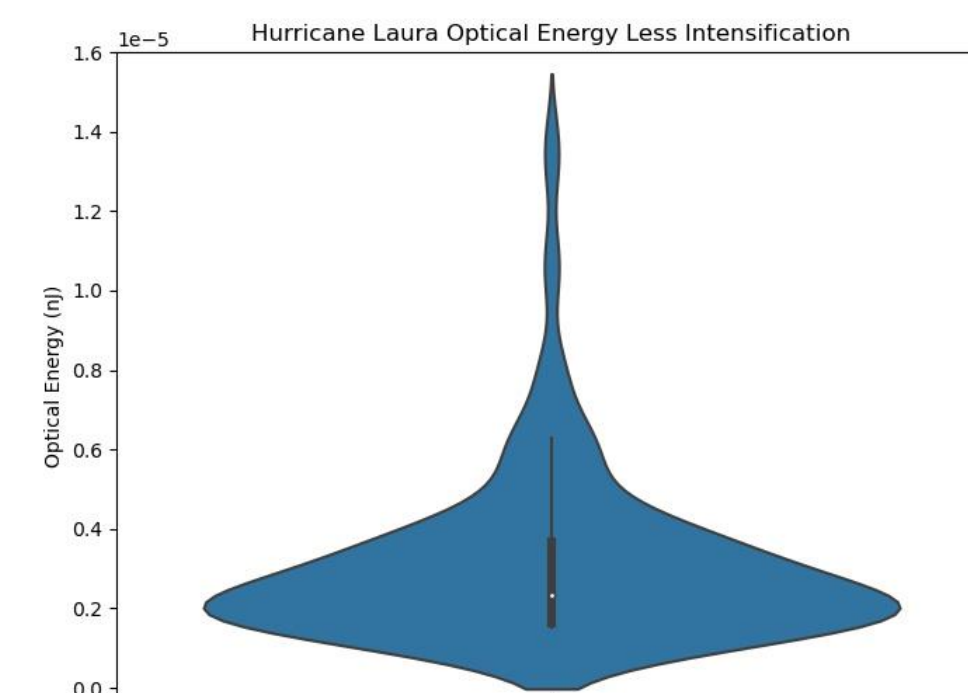


Figure 3: Distribution of optical energy values in Hurricane Laura during a 6-hour period (0600-1200) of less rapid intensification

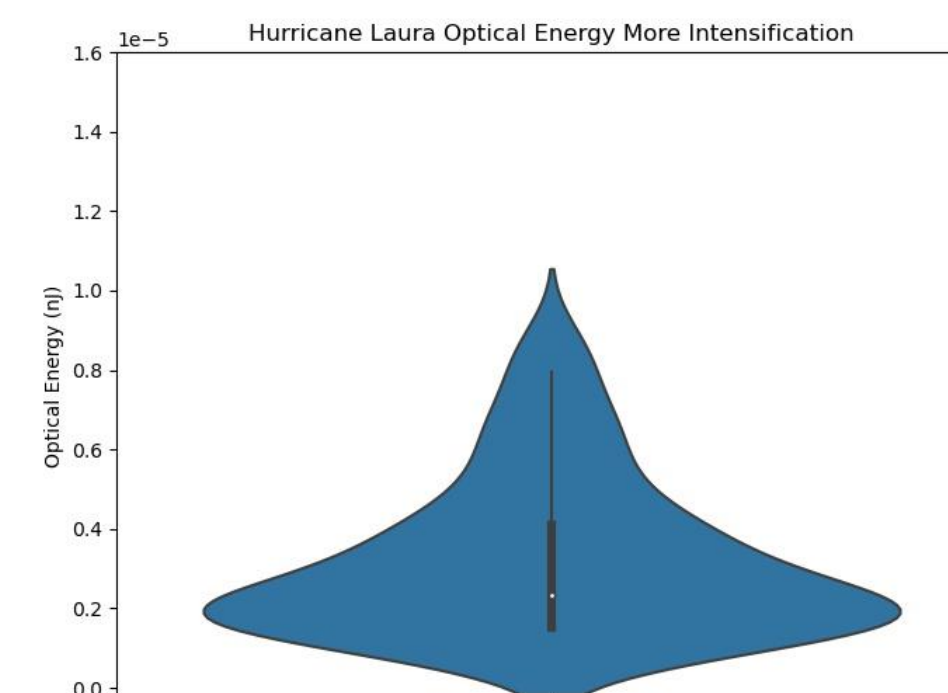


Figure 4: Distribution of optical energy values in Hurricane Laura during a 6-hour period (1200-1800) of more rapid intensification

- Higher optical energy values were recorded in the time with less intensification
- The quicker intensification saw slightly more values of 0.5×10^{-5} to 1×10^{-5} nJ

Discussion

- These results indicate that optical energy, like AFA and FED, could be helpful tool in prediction and analysis of RI in TCs
- Both hurricanes display similar behavior, with optical energy roughly following the large spike in AFA and FED just prior to an increase in intensification
- Following this, during the quickest intensification, the optical energy seems to be less correlated with AFA and FED

Hurricane Florence

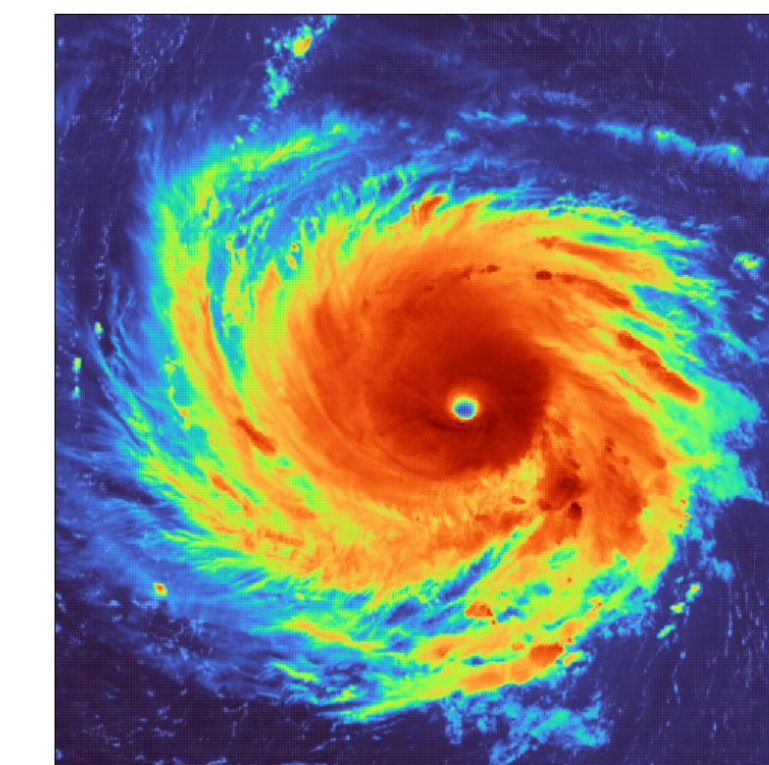


Figure 5: Infrared image from the GOES-16 satellite using band 13 to show brightness temperatures in Hurricane Florence on 10 September 2018 at 1800Z

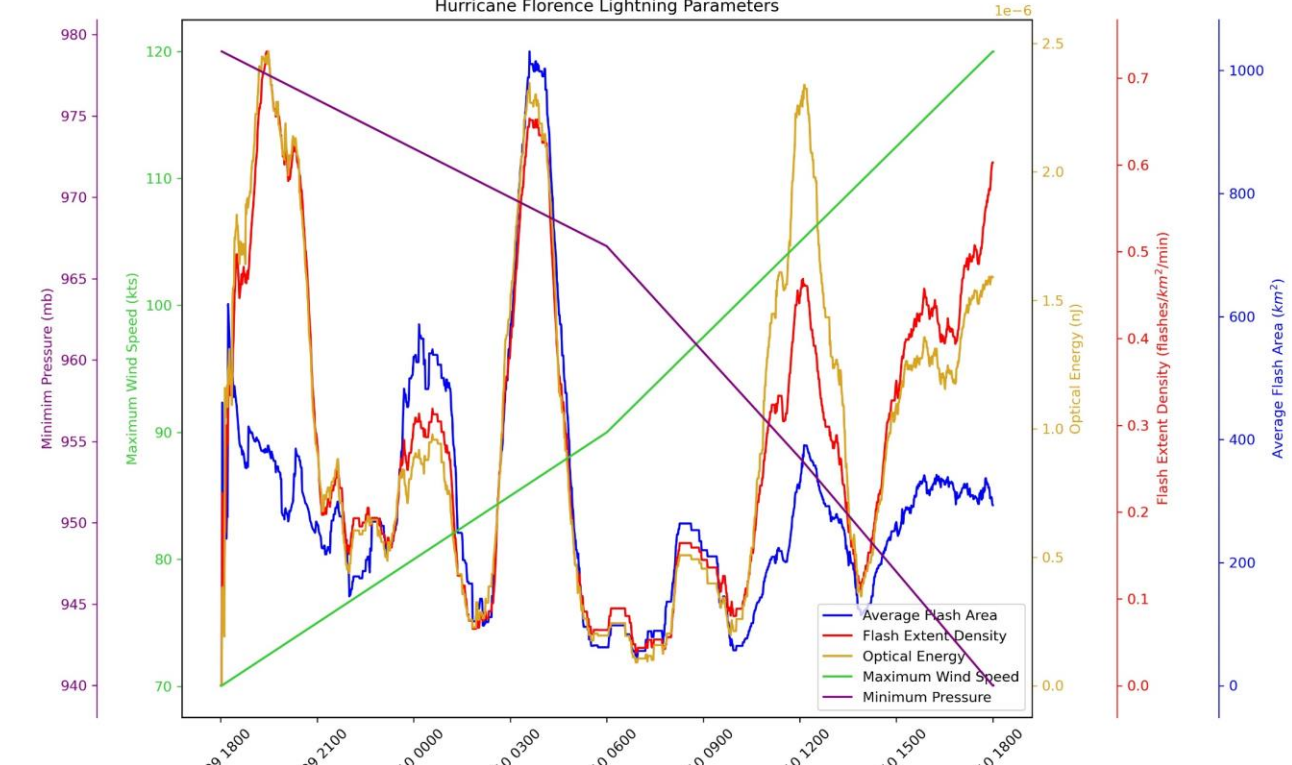


Figure 6: Maximum wind, minimum pressure, AFA, FED, and optical energy in Hurricane Florence from 09 September 1800Z to 10 September 1800Z

- Hurricane Florence, like Laura, had a large spike in AFA, FED, and optical energy just prior to an increase in intensification rate
- Optical energy deviated from AFA and FED during this increasing intensification, spiking above them

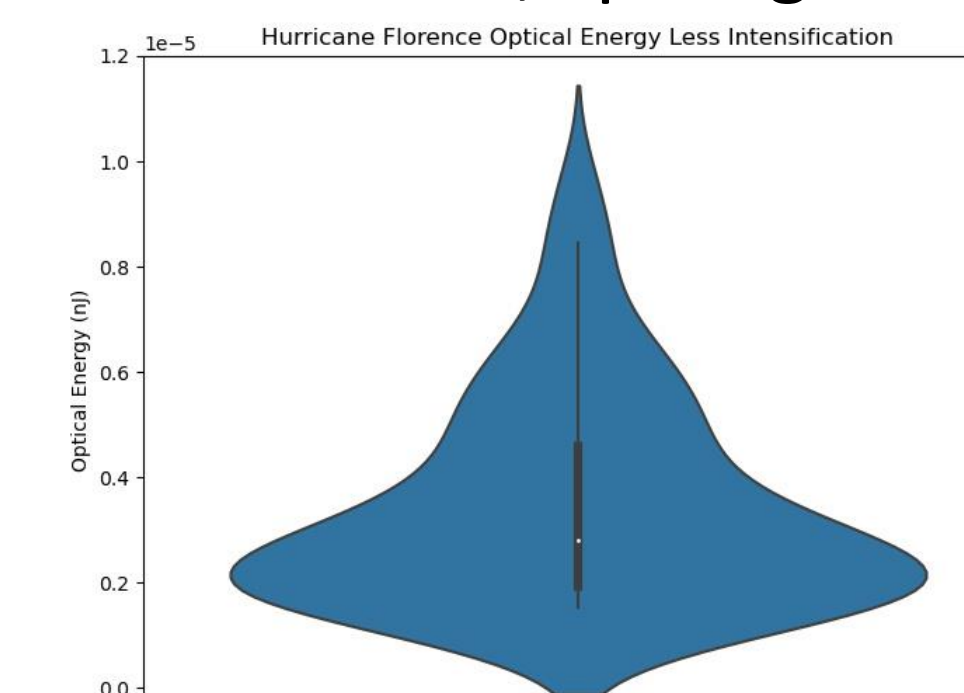


Figure 7: Distribution of optical energy values in Hurricane Florence during a 6-hour period (0000-0600) within RI with less intensification

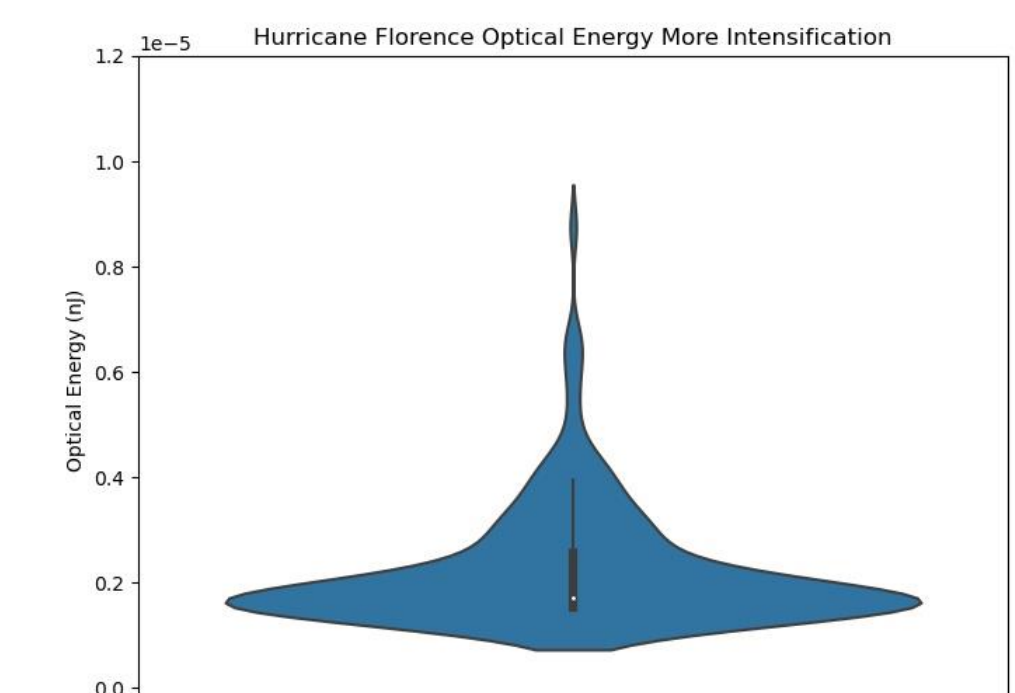


Figure 8: Distribution of optical energy values in Hurricane Florence during a 6-hour period (1200-1800) within RI with more intensification

- The optical energy values were distributed low for both time periods, but higher recorded values for slower intensification again
- The quicker intensification period is lacking in higher values (1×10^{-5} nJ to 1.2×10^{-5} nJ)

Future Work

- Investigating further into Hurricane Laura and Hurricane Florence may provide a better picture as to why the optical energy deviates during increased intensification
- Studying parameters like updraft strength and charge separation using microwave imagery may give more insight as to what is happening within these TCs and how these physical properties affect the lightning and RI